Thermal Soaring Forecasting

Michael F. Stringfellow

Introduction

- Thermals
  - Columns of warm air that rise from the ground when heated by the sun
- Soaring
  - Sustained engineless flight using natural sources of lift

Definitions

- Boundary or mixing layer
  - The zone of the atmosphere near the ground where thermals occur
- Lapse Rate
  - Fall of air temperature with altitude
- Dew Point
  - Temperature at which moisture vapor in the air condenses
- Skew-T Chart
  - Fancy diagram used by meteorologists to plot lapse rate and relative humidity

Making Thermals

- Conditions for thermals
  - Sun heats the ground
    - Little cloud cover
    - Dry soil
  - Pools of warm air can form
    - Light winds or shelter
  - Thermal triggers
    - Mechanical disturbance (man-made or natural)
  - Hot air near the ground has buoyancy
    - Air above is lighter (cooler or drier)

Thermal Characteristics

- When triggered, hot air rises
- If surrounding air is lighter, thermal continues rising
- Thermal stops when it reaches temperature of surroundings
- Thermal strength depends on difference of temperature between it and surrounding air
  - Thermal Index

Thermal Forecasting

- Estimate solar heating of ground
  - Cloud cover
  - Time of year/day
- Estimate lapse rate and dew point of air
  - Actual and forecast soundings
  - Strength of thermals
  - Boundary layer depth (top of thermals)

Forecasting Tools

- National Weather Service
- NOAA
- Dr. Jack's Blipmaps
- Soaring forecasts

Forecasts from Soundings

-3 TI at 7,500 feet

Forecast high taken from TUS
7-APR-2005 12 UTC Soaring report from TUS upper air data.
Forecast high: 90 F; est. base of any clouds:16400 feet AGL.

=== Raw Upper-Air Data ===

Feet MSL:	2585	3645	4946	10316	16811	18000	18243	18537	19082	20
Pres mb:	924	890	850	700	547	522	517	511	500	
Temp C:	19.4	21.8	20.0	8.8	-7.1	-10.5	-11.3	-11.7	-13.3	-1
VirT C:	19.8	22.2	20.4	9.1	-7.0	-10.1	-10.9	-11.4	-13.0	-1
DewPt C:	-7.6	-9.2	-10.0	-15.2	-33.1	-15.1	-15.2	-18.7	-19.3	-2
Wdir@kts:			135 16	225 10					230 22	

=== Interpolations (temps in deg. F, altitudes in feet MSL) ===

MSL	*TI*	Wdir@kts		trig	VirT	2.0 degrees/division ("`": Dry Adiabatic)
18000	3.1			95	13.8	` :
17500	2.9			95	16.1	` :
17000	2.7			95	18.5	` :
16500	2.5			94	20.7	` :
16000	2.2	225	21	94	23.0	` :
15500	2.0			94	25.2	` :
15000	1.8	220	15	93	27.4	`:
14500	1.5			93	29.7	`:
14000	1.3	225	14	92	31.9	`:
13500	1.0			92	34.1	:
13000	0.8			91	36.4	:
12500	0.5			91	38.6	`:
12000	0.3	240	11	90	40.8	:
11500	0.0			90	43.1	:
11000	-0.2			90	45.3	:
10500	-0.4	225	10	90	47.5	:`
10000	-0.8	220	11	89	49.6	:`
9500	-1.2			89	51.4	:`
9000	-1.7	215	10	88	53.3	: `
8500	-2.1			87	55.2	: `
8000	-2.5	195	9	86	57.1	: `
7500	-3.0			86	59.0	: `
7000	-3.4	165	8	85	60.9	: `
6500	-3.8			84	62.8	: `
6000	-4.3	140	12	83	64.7	: `
5500	-4.7			82	66.6	: `
5000	-5.1	135	16	82	68.5	: `
4500	-5.9			80	69.8	: `
4000	-6.7	130	21	79	71.0	: `
3500	-8.0			77	71.3	: `
3000	-10.6	125	18	72	69.3	: `

How I Forecast Thermals

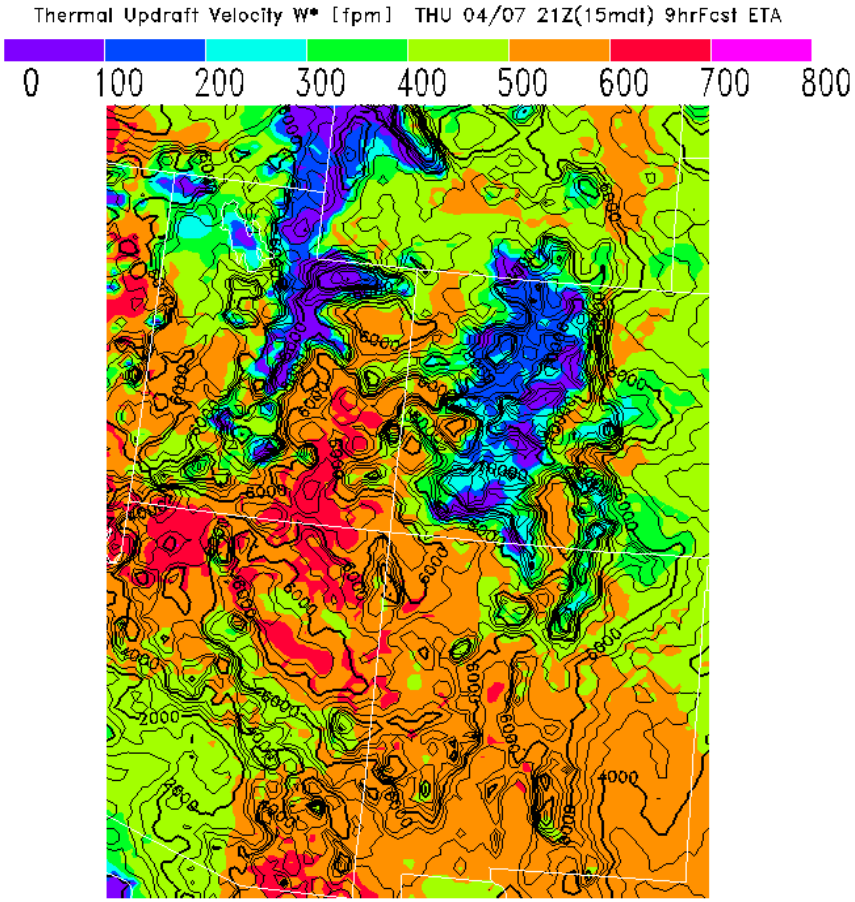
- Check actual and forecast weather
  - Weather Service, Webcams
- Check satellite maps
  - Visible, Infrared and water vapor
- Check Blipmaps
  - Thermal strength, top-of-the lift, buoyancy/shear ratio, cumulus prediction
- Check Forecast Soundings
  - Temperature, winds lapse rate, inversions, cloudbase, convective potential etc.

Soaring Forecast Page

- Seven main sub pages for forecasting:
  - Current Weather
  - Forecast Weather
  - Blipmaps & Blipspots
  - Mike the Strike's Forecast
  - Week's Soaring Forecast
  - Weather Links
  - Webcams

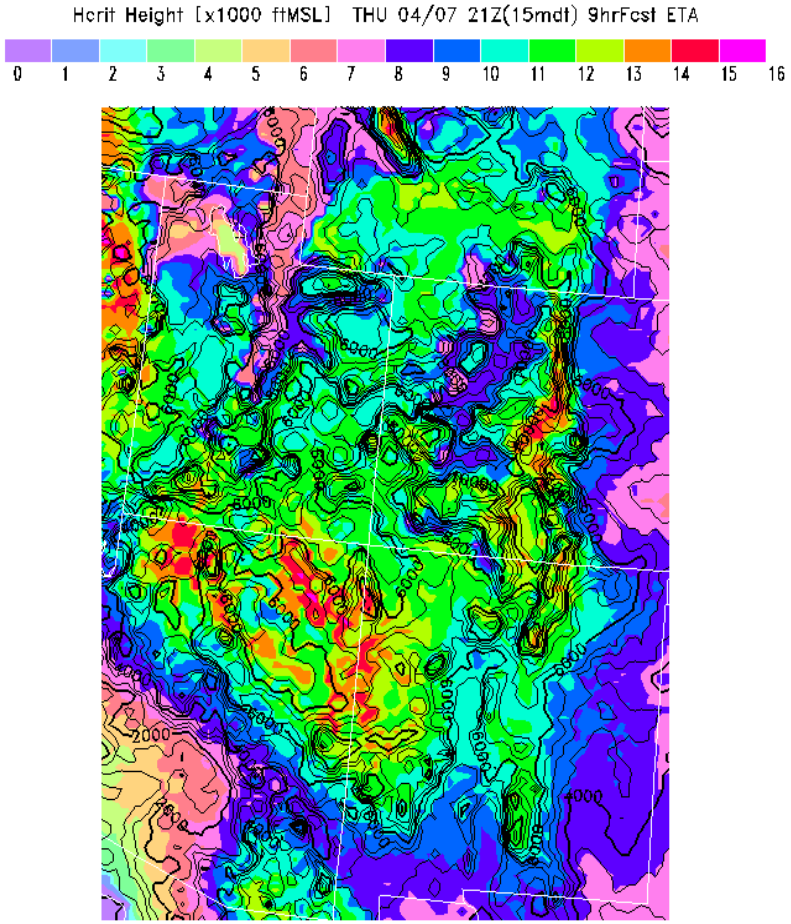
Reading Blipmaps - 1

- Thermal Strength
  - Predicted average net thermal strength
  - Subtract glider minimum sink rate to estimate actual rate of climb
  - Remember thermals will vary from weak to strong



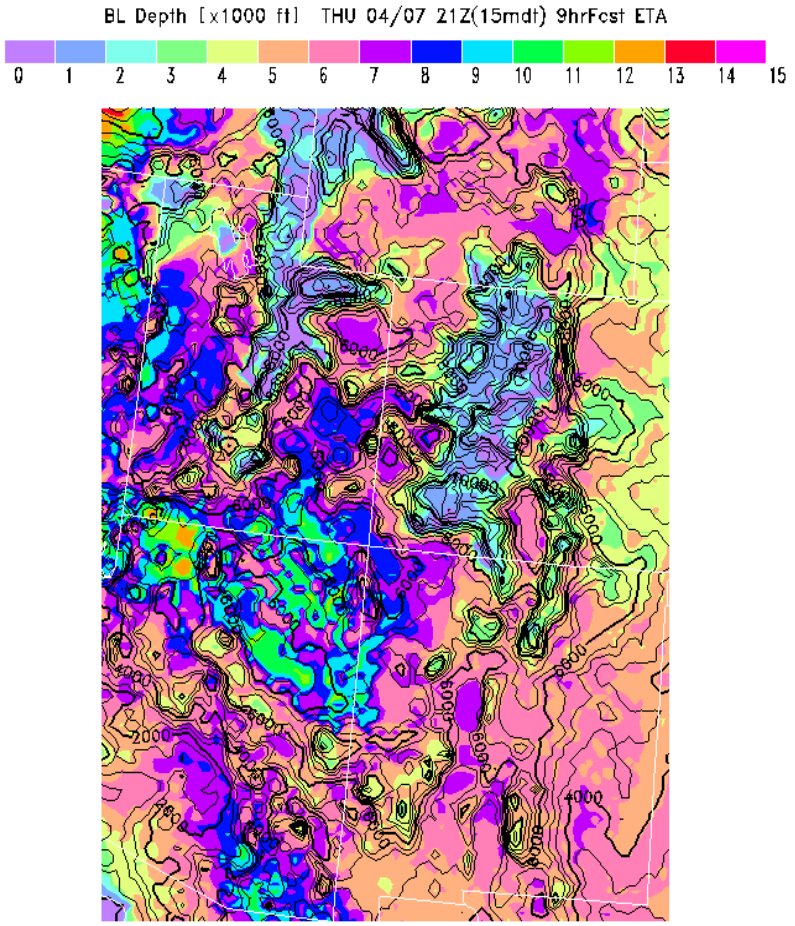
Reading Blipmaps - 2

- Top of the lift
  - Hcrit is top of the lift experienced by a glider in feet MSL
  - Usually at the –3 TI point on the Skew-T chart



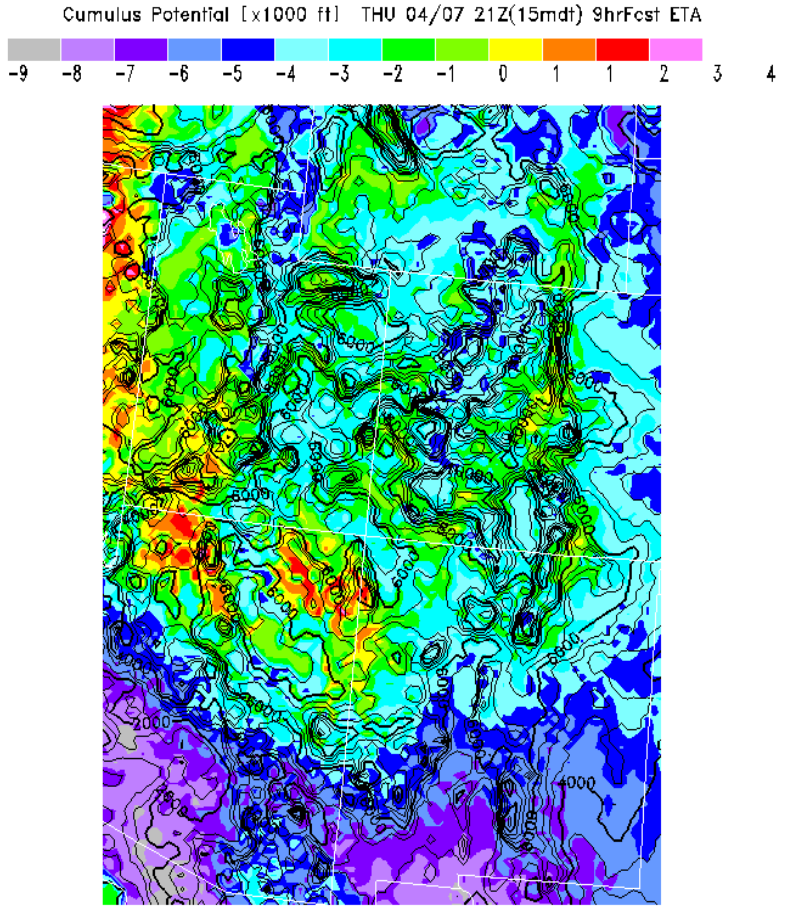
Reading Blipmaps - 3

- Boundary Layer Depth
  - Height of thermals above the ground in feet
  - Remember you won't usually get this high in a glider



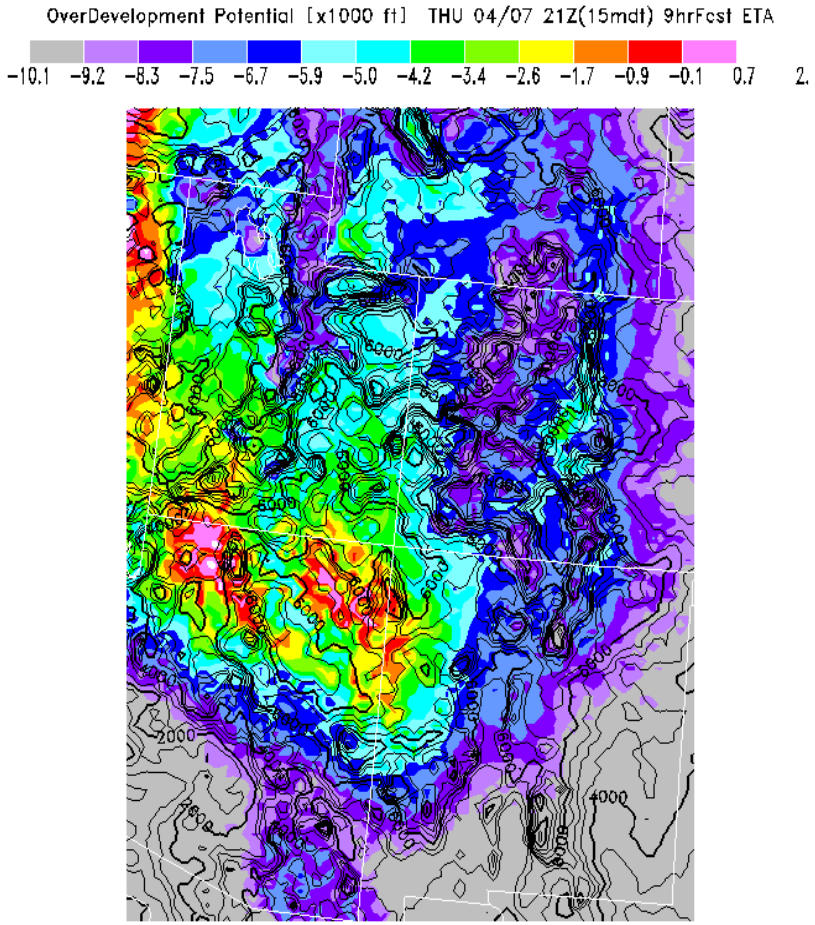
Reading Blipmaps - 4

- Cumulus Potential
  - Chance of thermal-generated cumulus clouds



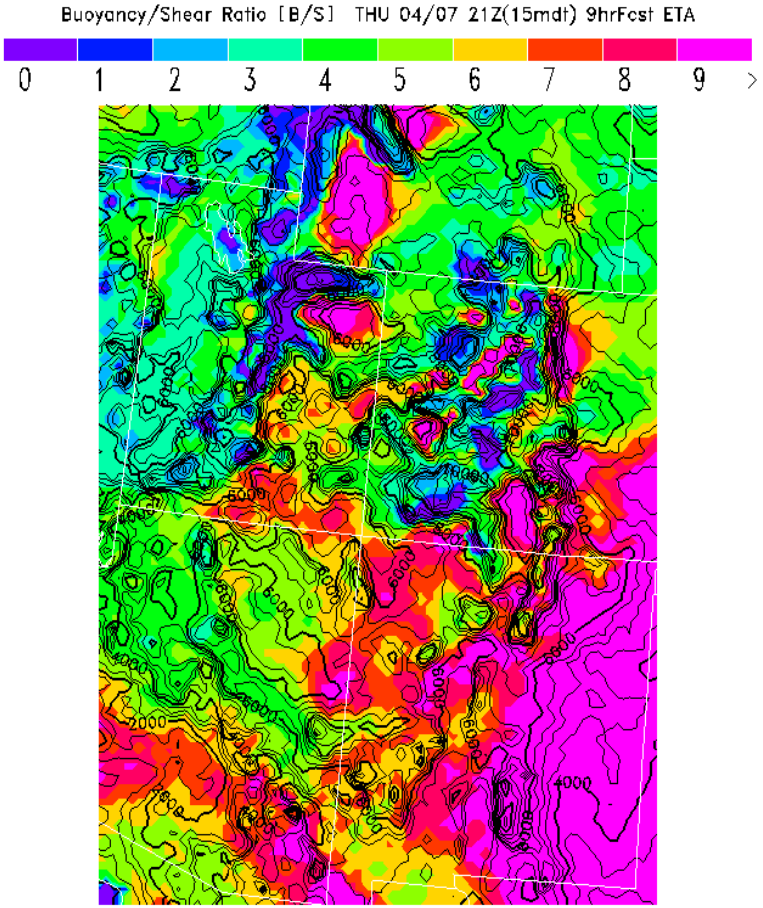
Reading Blipmaps - 5

- Overdevelopment Potential
  - Chance for showers and thunderstorms
  - Usually not good when too high!



Reading Blipmaps - 6

- Buoyancy/Shear Ratio
  - Indicates chance of thermals blowing apart in wind
  - Less likely with strong thermals or weak winds
  - >5 is usually OK
  - <5 thermals broken



Reading Blipspots

DrJack's BLIPSPOT for: THU 04/07 LakePleasant_AZ 1580ft pt24768@-112.197,33.735,1795ft

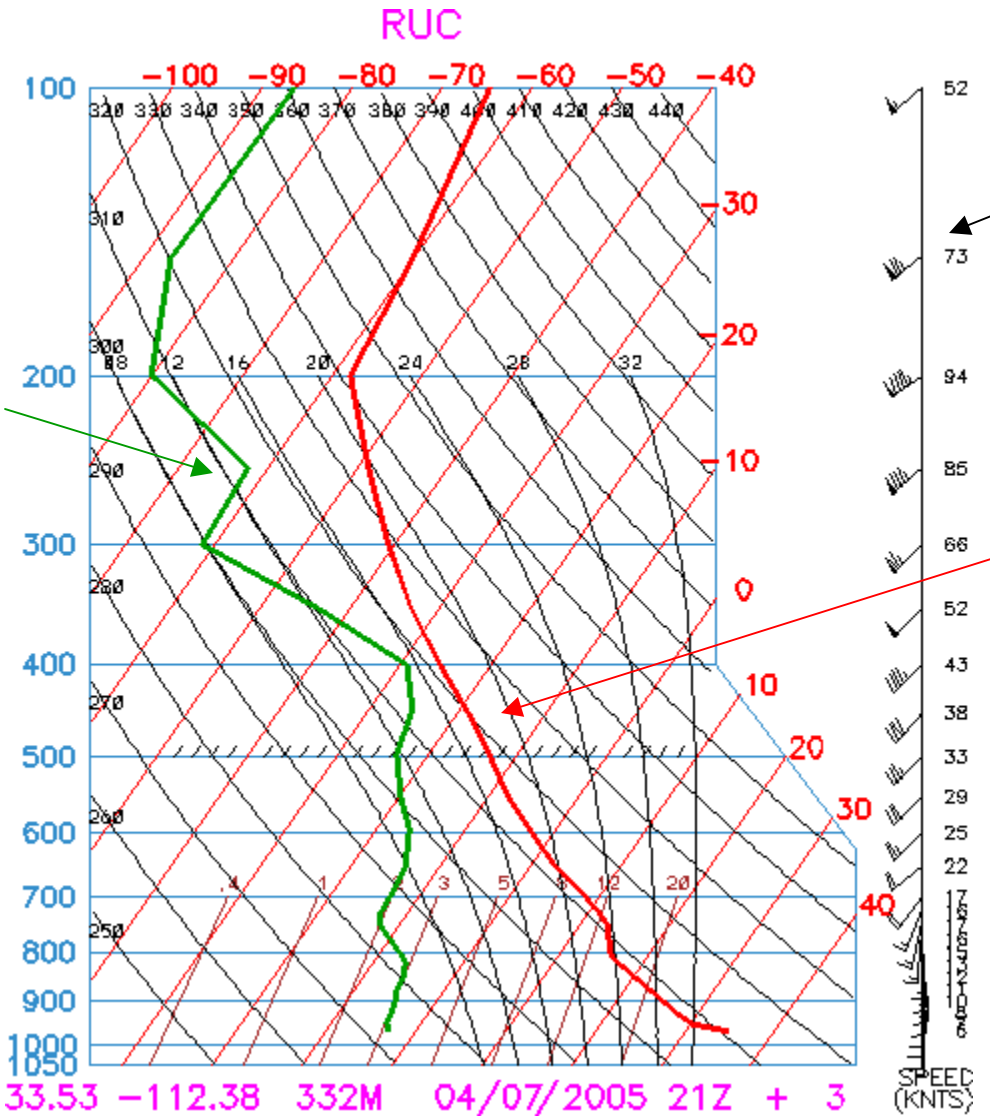
BLIPSPOT sfc.temp. adjusted by -0.7 degF
SPONSORED BY: Ted Grussing

RUC - Last Analysis,Validation Time = 18Z 3Z

Data for 2 PM Local

	VALIDATION TIME												
	15Z	16Z	17Z	18Z	19Z	20Z	21Z	22Z	23Z	0Z	1Z	2Z	3Z	
FCST PERIOD	6 hr	-	-	6 hr	-	-	6 hr	-	-	6 hr	-	-	9 hr	FCST PERIOD
Temp@2m	67.7	-	-	83.6	-	-	91.3	-	-	88.4	-	-	79.4	Temp@2m
Sfc.Heating	67	-	-	451	-	-	498	-	-	99	-	-	-27	Sfc.Heating
BL Depth	215	-	-	4128	-	-	6265	-	-	5081	-	-	215	BL Depth
Hcrit	1580	-	-	4488	-	-	6226	-	-	4396	-	-	1580	Hcrit
BL Top	1795	-	-	5708	-	-	7845	-	-	6661	-	-	1795	BL Top
Hgt.Variab.	1482	-	-	1999	-	-	3442	-	-	1827	-	-	927	Hgt.Variab.
W*	99	-	-	501	-	-	596	-	-	324	-	-	0	W*
B/S	2	-	-	6	-	-	8	-	-	4	-	-	0	B/S
BL Wind	9	-	-	14	-	-	14	-	-	13	-	-	6	BL Wind
Direction	101	-	-	143	-	-	174	-	-	220	-	-	269	Direction
Wind Shear	0	-	-	5	-	-	10	-	-	9	-	-	0	Wind Shear
Max.Converg	-4	-	-	14	-	-	-11	-	-	13	-	-	2	Max.Converg
CLOUDpotent	-9510	-	-	-9907	-	-	-9092	-	-	-9636	-	-	-12505	CLOUDpotentl
sfcLCL	11305	-	-	15615	-	-	16938	-	-	16298	-	-	14301	sfcLCL
ODpotential	-15690	-	-	-13421	-	-	-11082	-	-	-11578	-	-	-15234	ODpotential
blCL	17485	-	-	19129	-	-	18927	-	-	18239	-	-	17029	blCL
maxRH	41	-	-	27	-	-	80	-	-	91	-	-	101	maxRH
Temp@2m	67.7	-	-	83.6	-	-	91.3	-	-	88.4	-	-	79.4	Temp@2m
DewPt@2m	26.8	-	-	22.1	-	-	23.4	-	-	24.1	-	-	25.1	DewPt@2m
Temp@Bot	67.3	-	-	81.0	-	-	88.5	-	-	87.7	-	-	79.6	Temp@Bot
DewPt@Bot	26.8	-	-	22.1	-	-	23.4	-	-	24.0	-	-	25.1	DewPt@bot
Sfc.Heating	67	-	-	451	-	-	498	-	-	99	-	-	-27	Sfc.Heating
BL Depth	215	-	-	4128	-	-	6265	-	-	5081	-	-	215	BL Depth

Reading Skew-T Charts



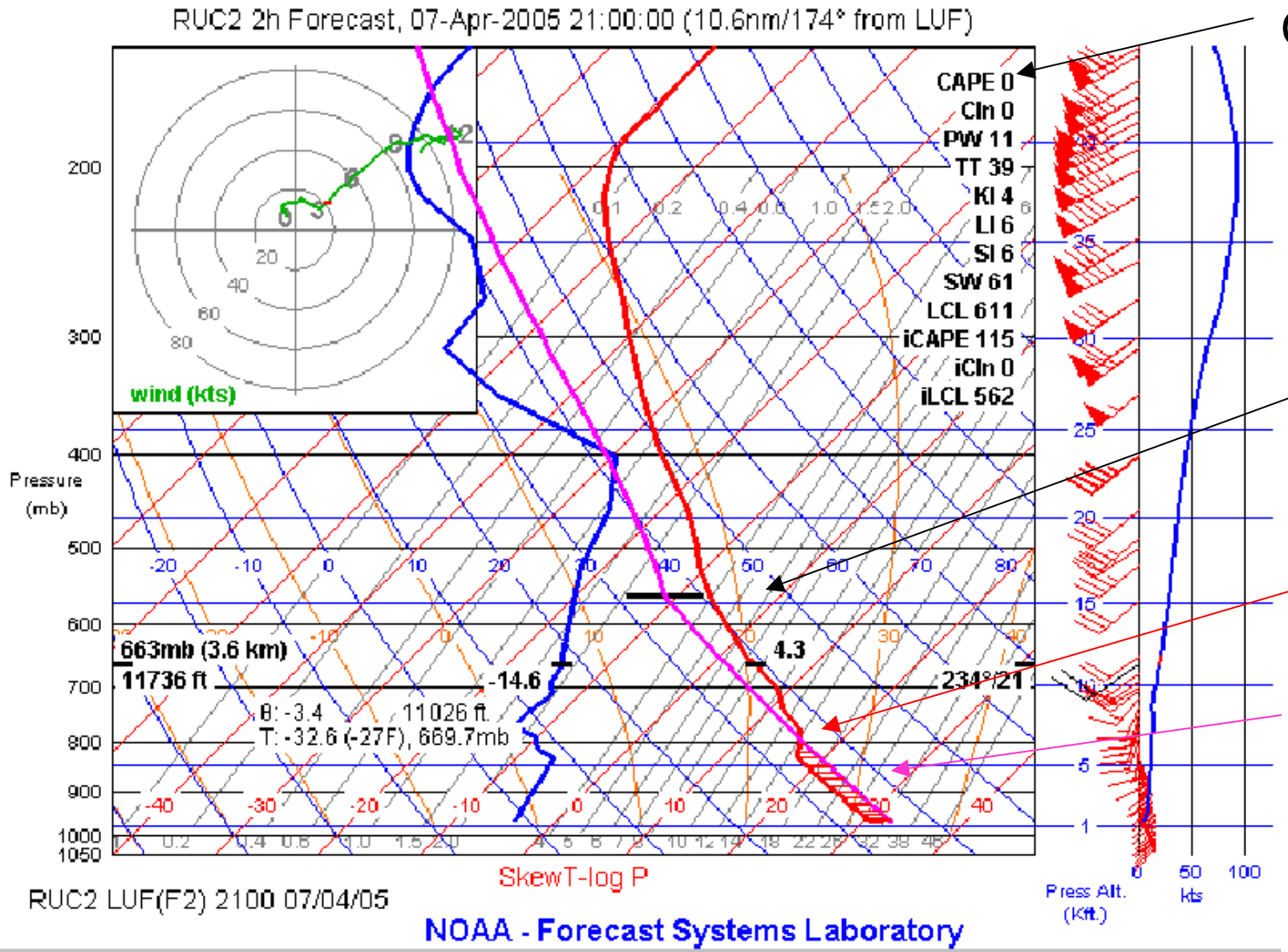
Predicted Dew Point Temperature

Atmospheric Pressure

Wind Speed & Direction

Predicted Air Temperature

Interactive Skew-T (Arizona)



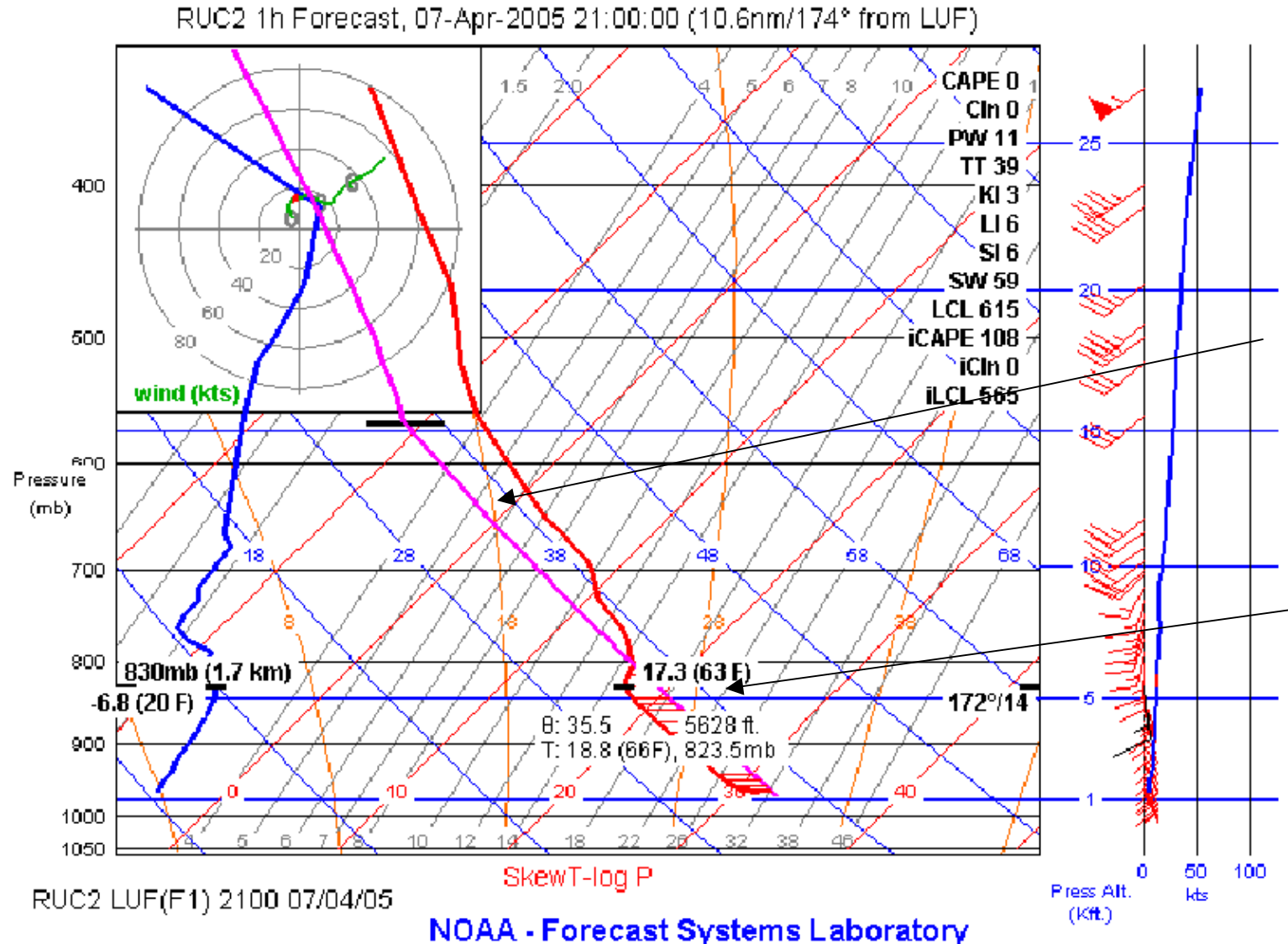
Convective Potential Energy

Predicted Cloud Base

Boundary Layer Top

Predicted Parcel Motion

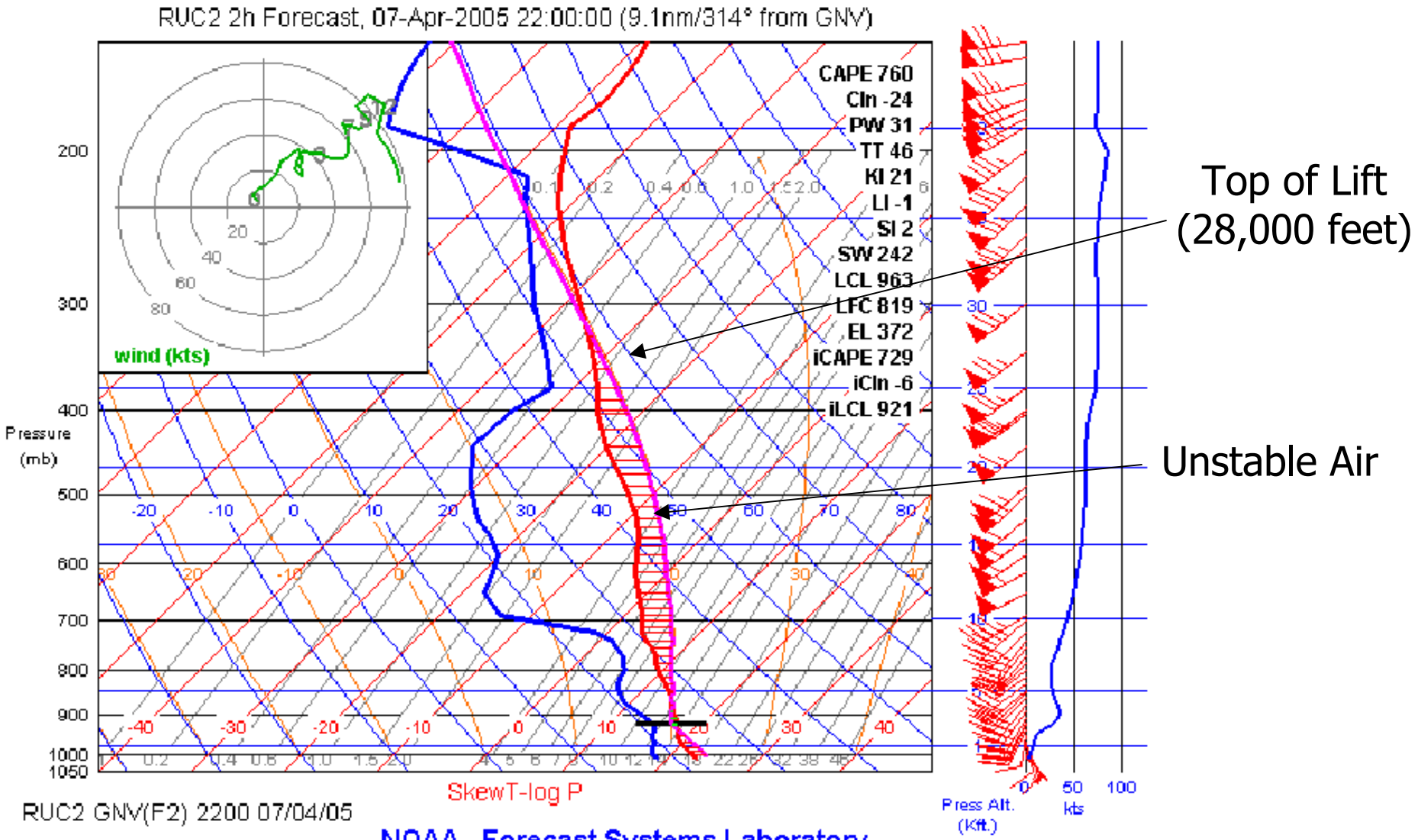
Interactive Skew-T (Arizona)



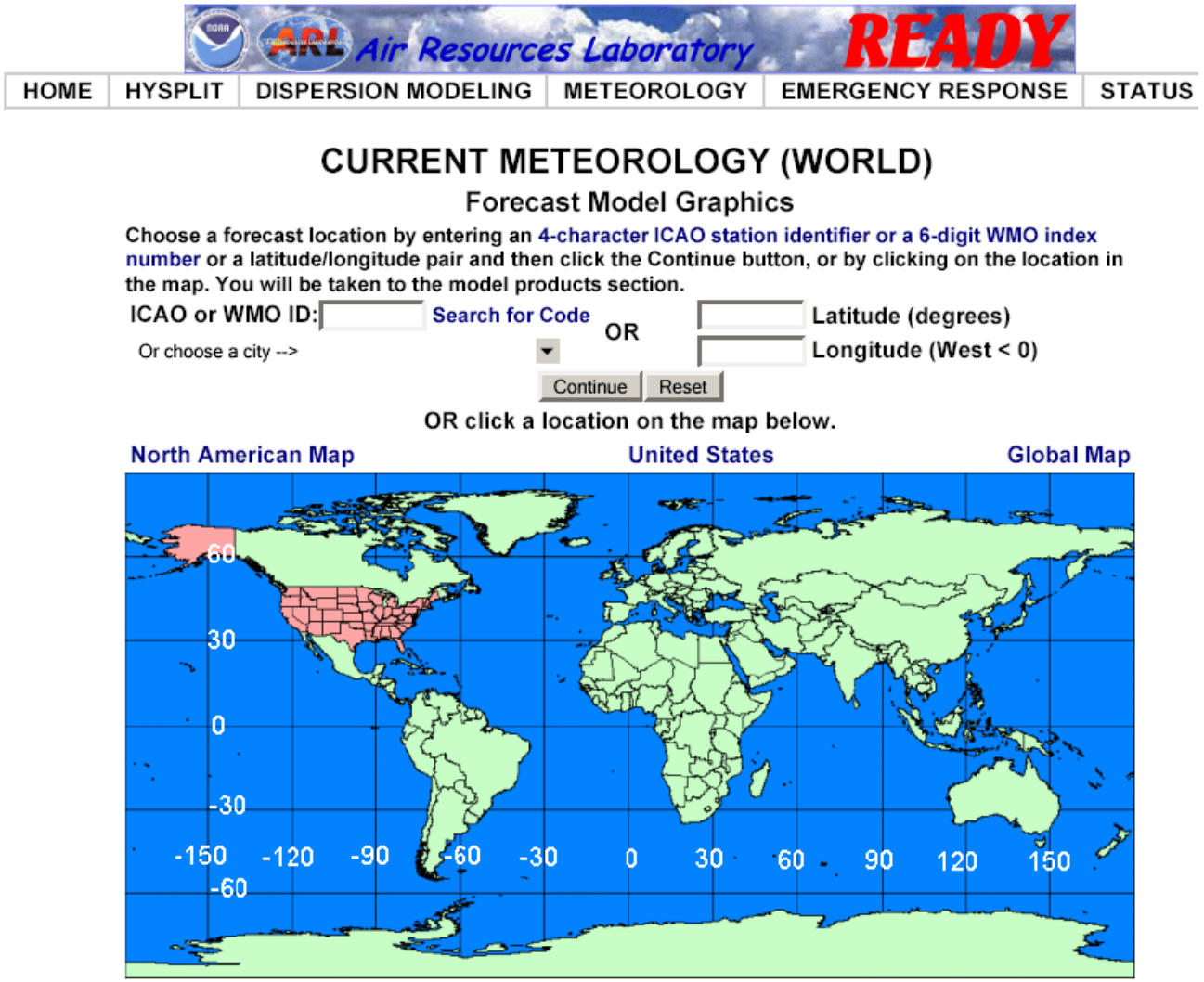
Stable Air

Top of the Lift (5,600 ft)

Interactive Skew-T (Florida)



NOAA's Ready Forecast Tools



NOAA Ready Menu

READY RUC Sounding Menu

HOME | HYSPLIT | DISPERSION MODELING | METEOROLOGY | EMERGENCY RESPONSE | STATUS

RUC Sounding

Time to plot (start time for animation):	April 07, 2005 at 21 UTC (+ 03 Hrs)				
Animation:	◉ None	○ GIF	○ Java	○ Javascript	Duration: 12 hours
Type:	◉ Full Sounding	○ Only to 400 mb			
Output:	◉ Graphic and text	○ Text only			
Graphics:	☑ Skew-T Log-P	☐ Theta	☐ Text Listing		

Graphic size (pixels): ○ 400 ○ 500 ◉ 700 ○ 900 ○ 1200

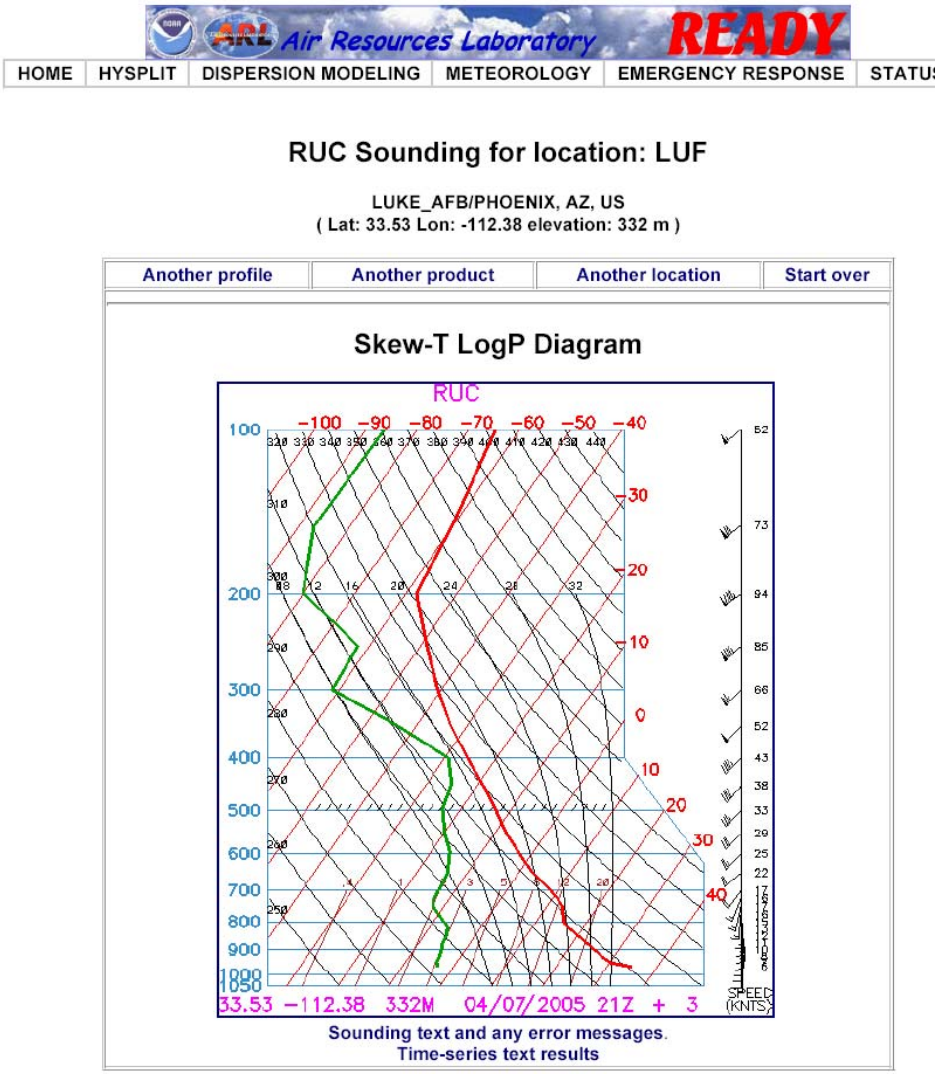
Type your access code (displayed at right) into the text box. This code is an image that cannot be read by a computer. This access code prevents automated programs from requesting access to READY products, which have saturated the system denying others from obtaining products in a timely manner.

READY Use Agreement

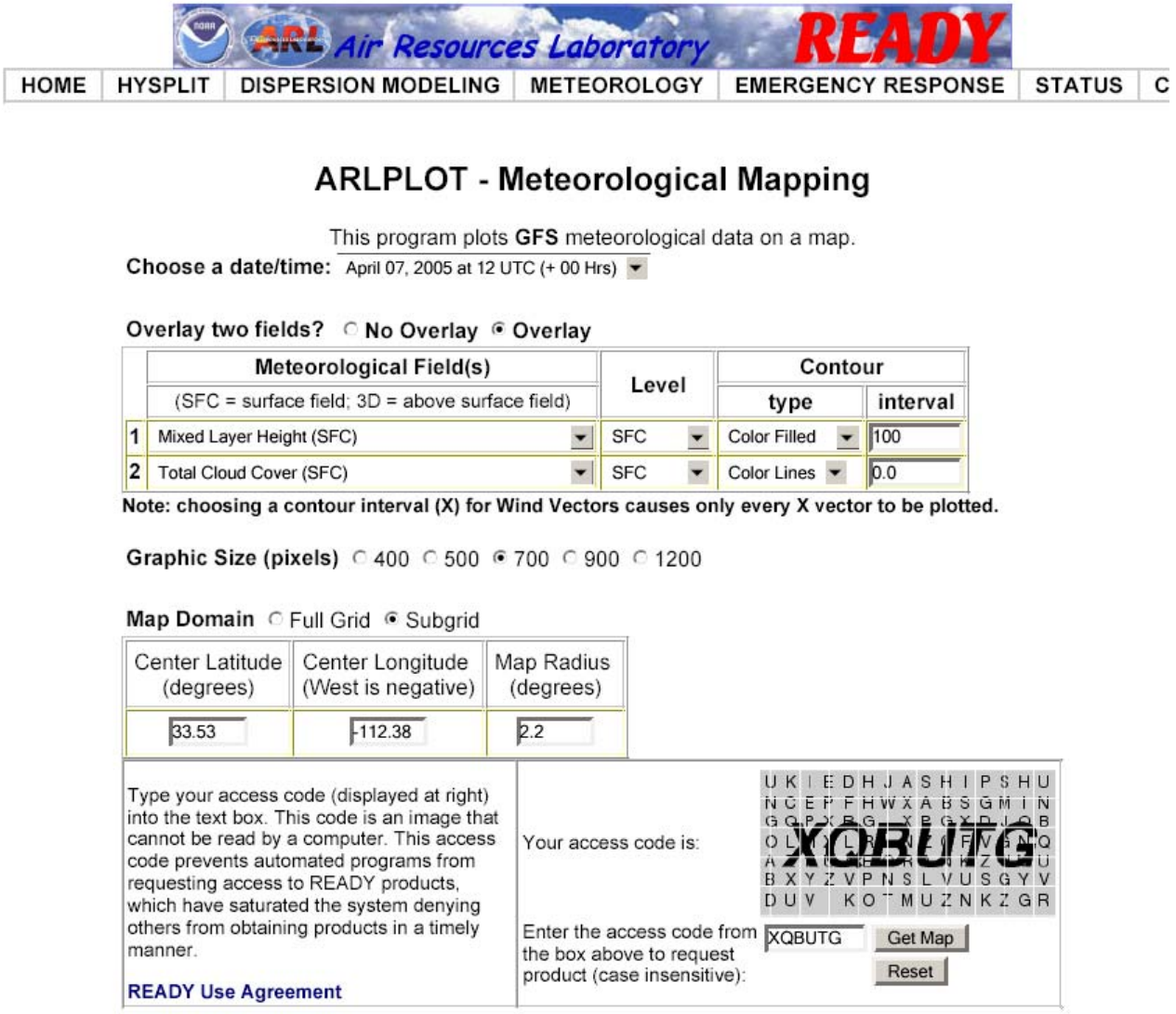
Your access code is: ISDFVD

Enter the access code from the box above to request product (case insensitive): isdfvd [Get Profile] [Reset]

READY RUC Sounding Result



Ready Interactive Map Menu



Resulting Map of Arizona

Air Resources Laboratory READY

HOME | HYSPLIT | DISPERSION MODELING | METEOROLOGY | EMERGENCY RESPONSE | STATUS

Map centered over: LUF

Another map | Another product | Another location | Start over

Runtime messages

NOAA Air Resources Laboratory

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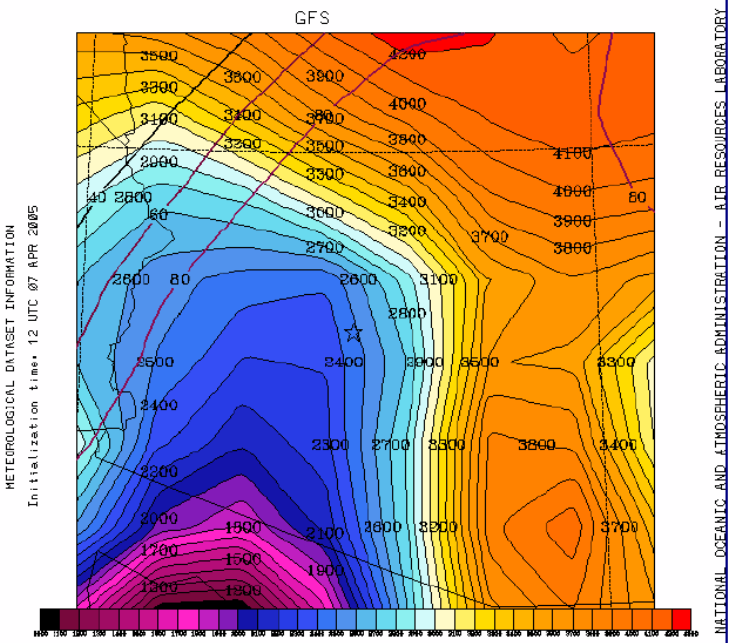
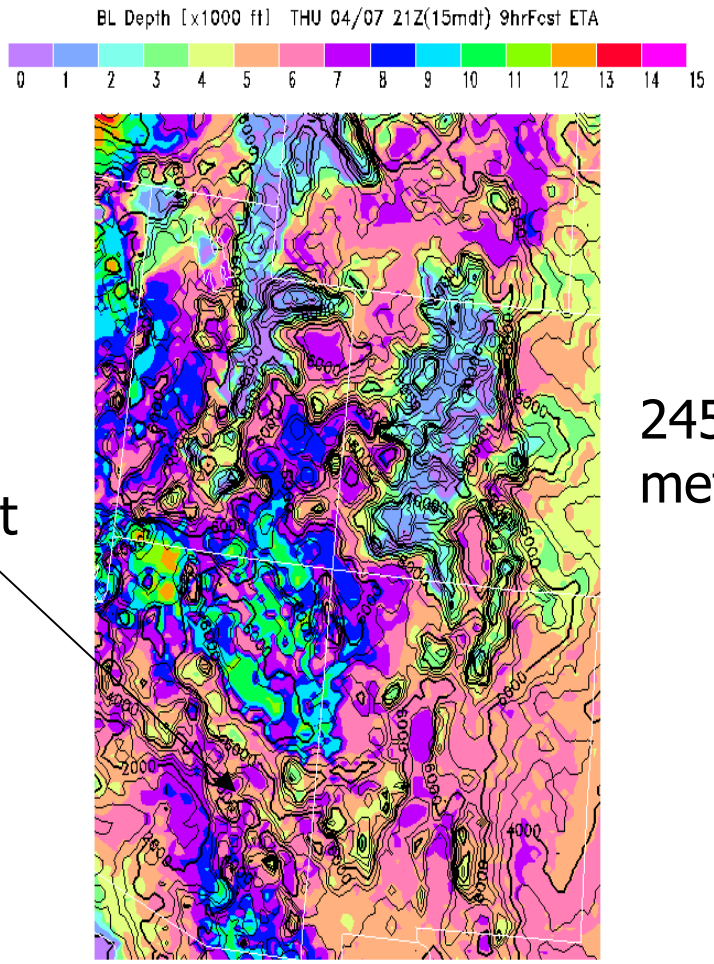
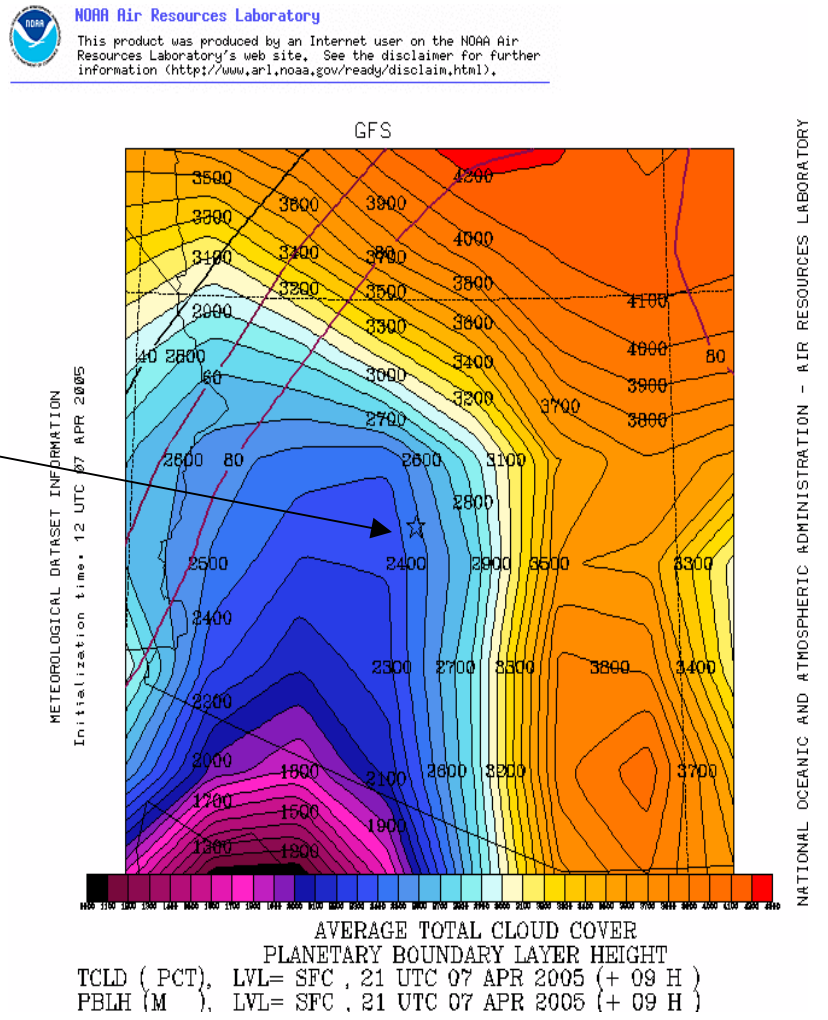


Boundary Layer Height



7845 Ft

2450 meters



Summary

- Check forecast weather
  - Sun
  - Cloud
  - Winds
  - Maximum temperature
  - Satellite images
- Check Blipmaps & Blipspots
  - Thermal strength
  - Top of Lift
  - Cumulus
  - Buoyancy/Shear
- Check Soundings
  - FSL Interactive
  - NOAA Ready
- Check Trends
  - High pressure building?
  - Dry air moving in?
- Watch the sky
  - Do conditions match the forecast?
  - Check temperatures